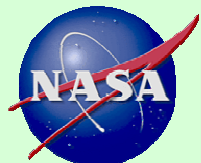


# AROTAL

## Measurement Capabilities

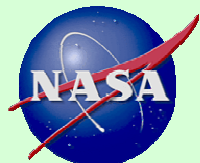
*T. McGee, L. Twigg, G Sumnicht*  
*GSFC*

*C. Hostetler*  
*LaRC*

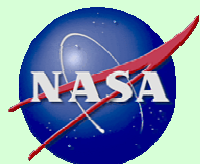
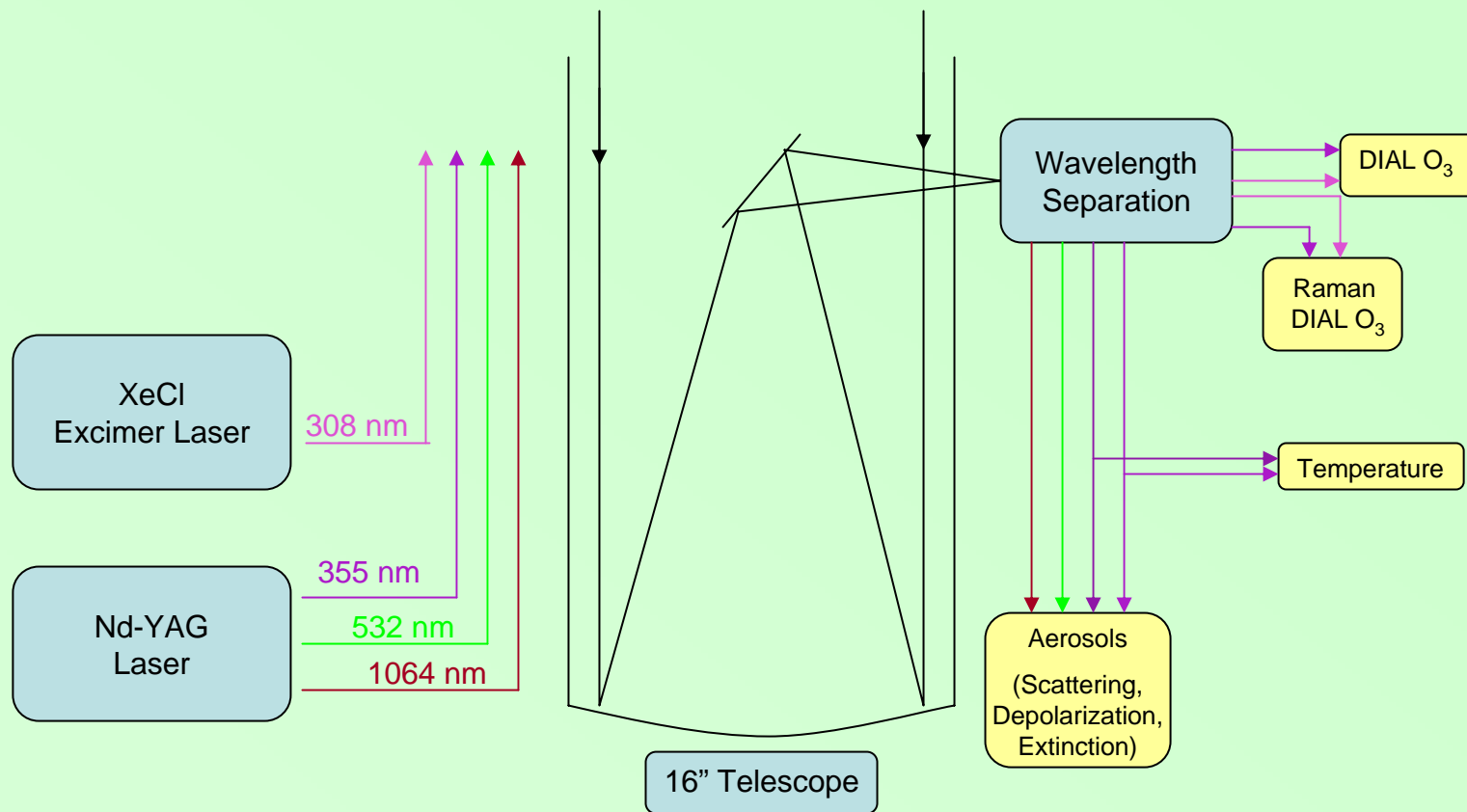


# AROTAL – Airborne Raman Ozone, Temperature and Aerosol Lidar

- Combines Rayleigh Lidar, Differential Absorption Lidar (DIAL), and Raman DIAL
  - Zenith viewing
  - Measures: Ozone (DIAL and Raman DIAL), Temperature (Elastic and Raman Scattering), and Aerosols (UV backscatter and extinction)
  - Transmits 308 and 355 nm radiation (can also transmit 532 and 1064 nm)
  - Receives 308, 332 (N<sub>2</sub> Raman from 308), 355, 387 (N<sub>2</sub> Raman from 355)
  - Aerosol Backscatter at 1064 and 532 nm
  - Aerosol Depolarization at 532 nm
- } **LaRC Data Product**



# AROTAL Schematic



# Measurements

## → Ozone

- $O_3$  proportional to the difference of the slopes of the returns from 308 nm (absorbed by  $O_3$ ) and 355 nm (not absorbed) – Differential Absorption (DIAL) technique

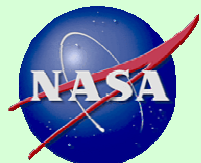
## → Temperature - SZA > 91 - 92°

- 355 nm return is a relative density profile
- Assume hydrostatic equilibrium
- Initialize at high altitude with climatological temperature
- Integrate downward using Ideal Gas Law to extract temperature
- Converges in ~2 scale heights.
- Raman scattering can be used in regions of aerosols or optically thin clouds

## → Aerosols from UV Wavelengths

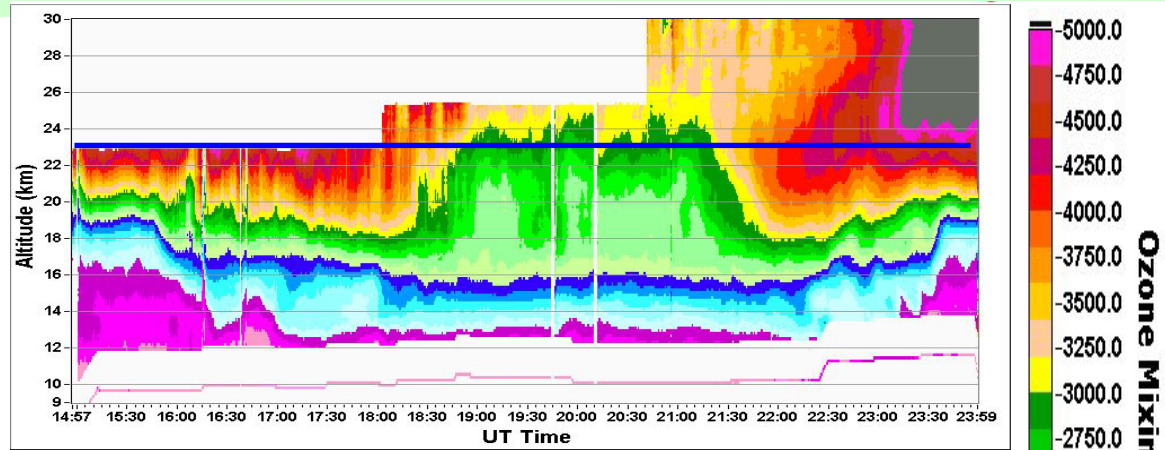
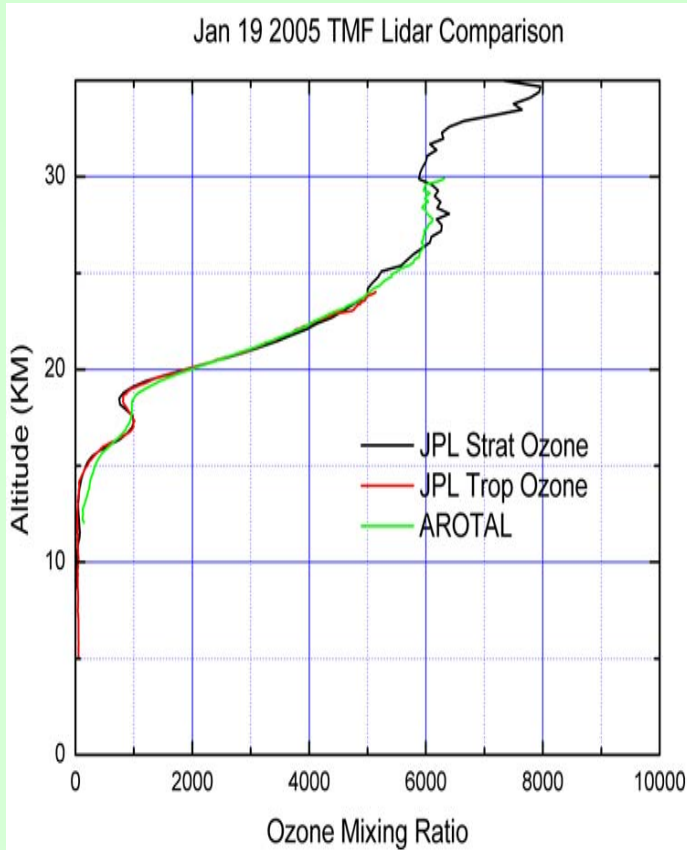
- Backscatter ratio from ratio of Elastic/Raman
- Extinction from elastic and Raman returns
- Klett retrieval with single wavelength

} SZA > 97°

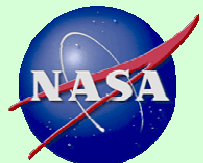
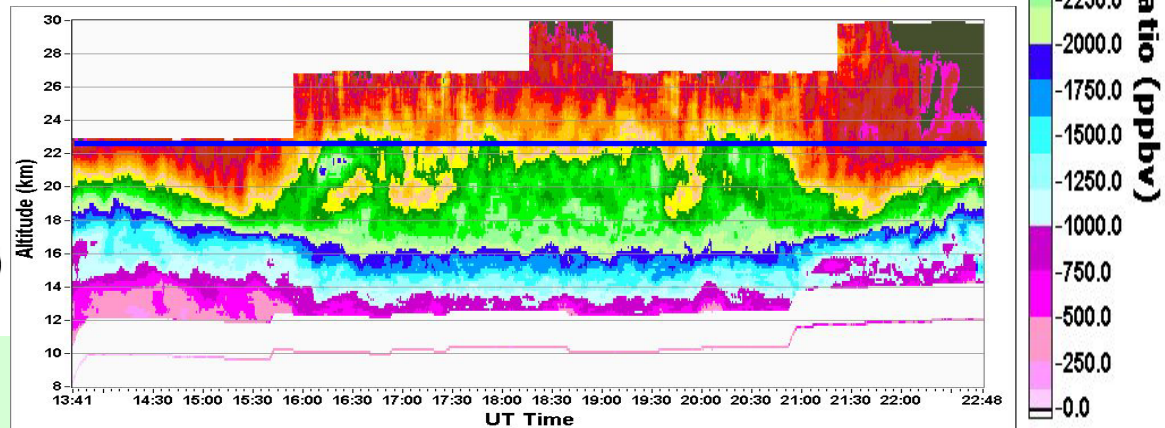


# AROTAL Ozone Measurements during PAVE

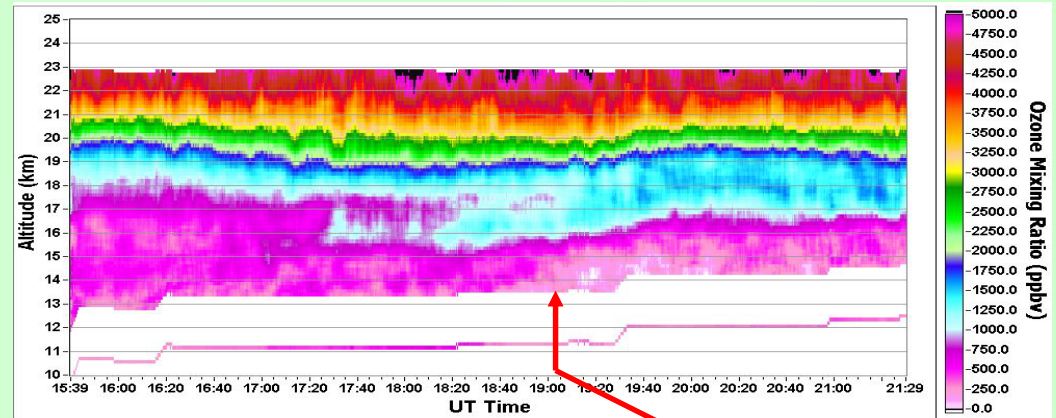
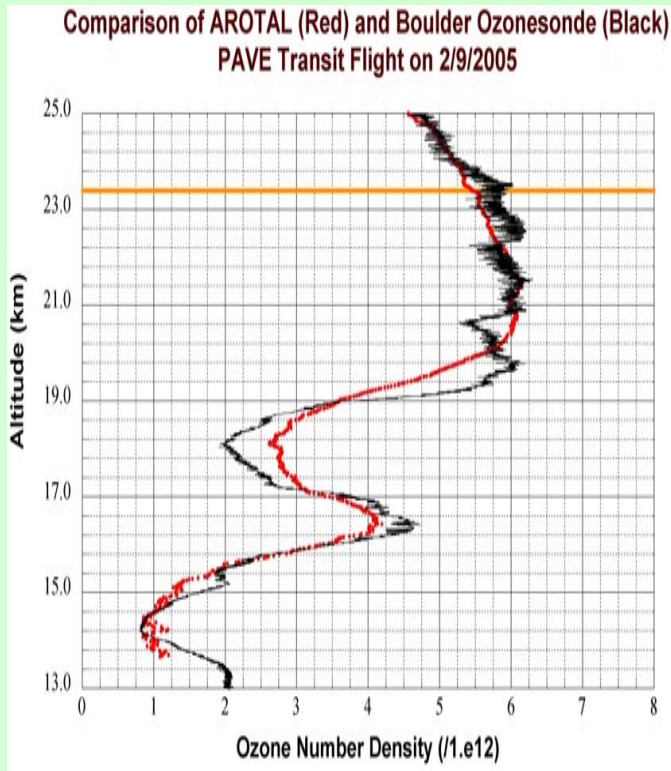
January 27, 2005



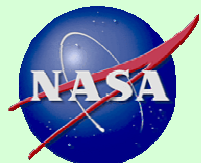
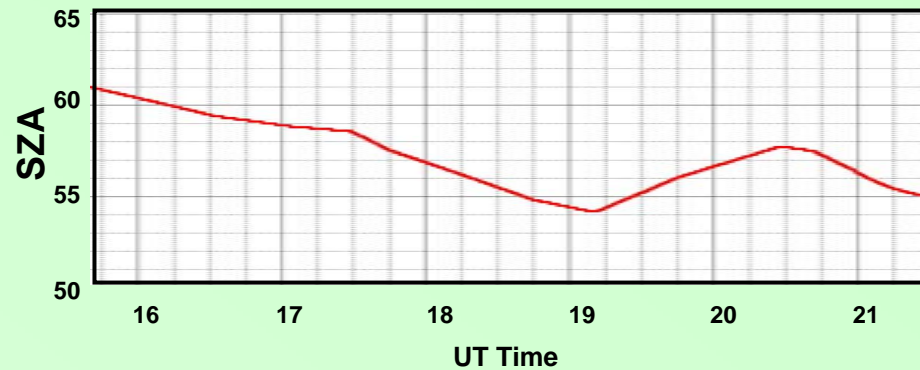
January 31, 2005



# February 9, 2005 Transit Flight



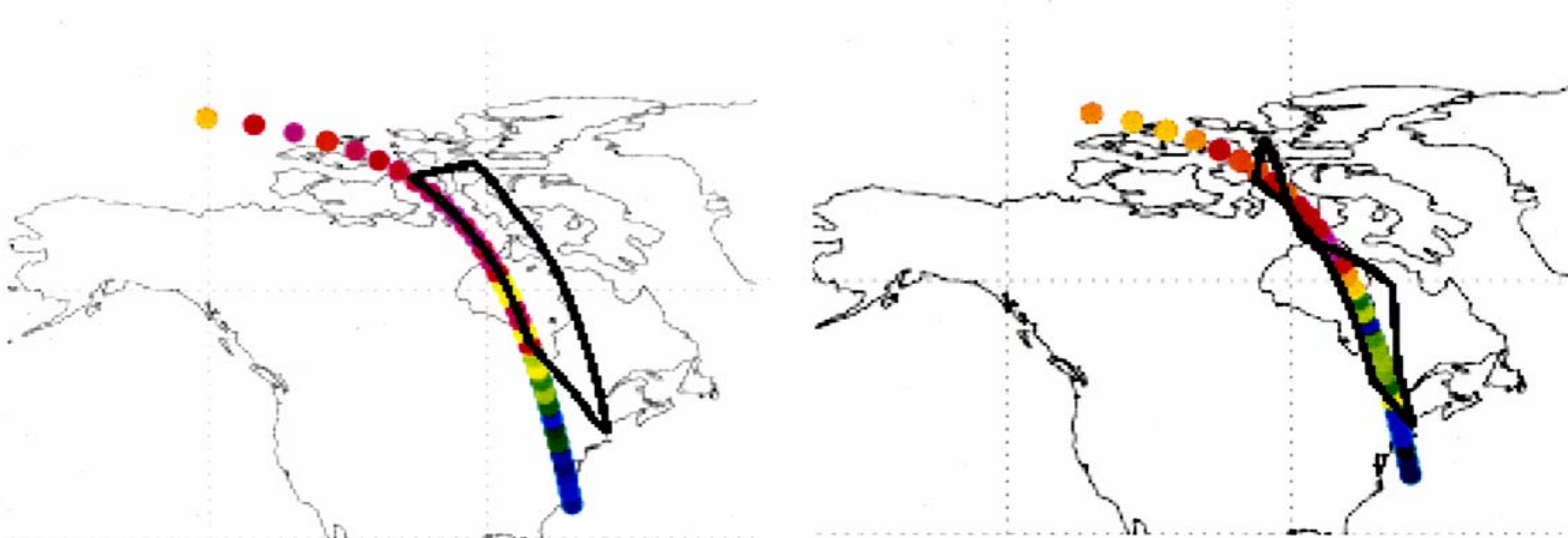
Approximate Boulder Overpass



# PAVE – MLS Flight Tracks

The DC8 flew from Portsmouth, North and deep into the vortex along the satellite track (MLS or TES track) on Jan. 27, 31, and Feb. 5, 2005.

- DC8 did not go as far North on Jan. 29, and other day(s).



Jan. 27

Jan. 31

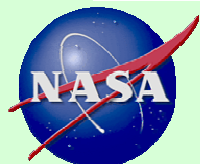
MLS profiles in color.

DC-8 track in black.

Aura Validation Meeting, Pasadena

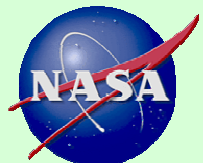
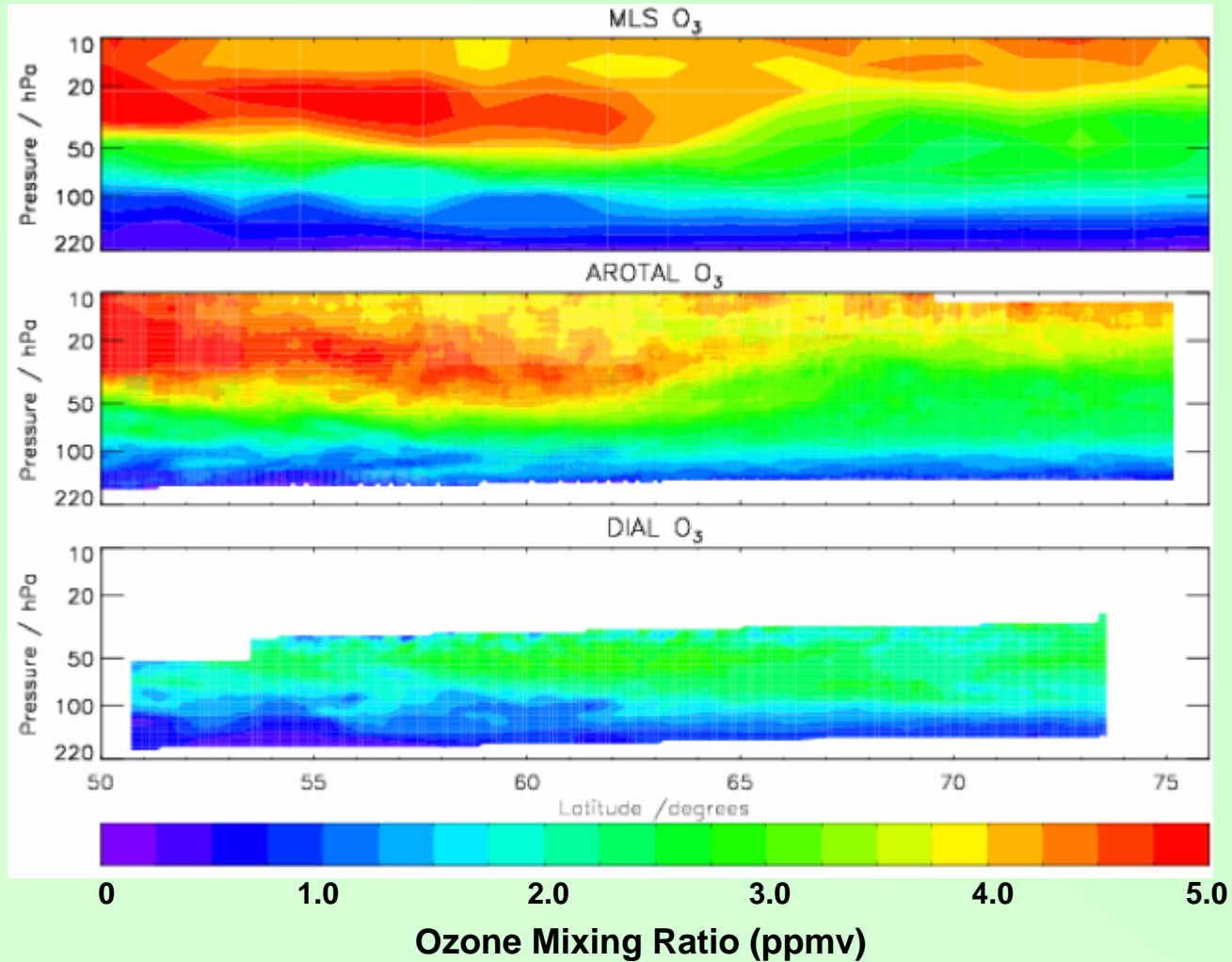
March 1, 2005

L. Froidevaux et al.



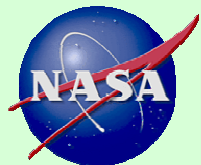
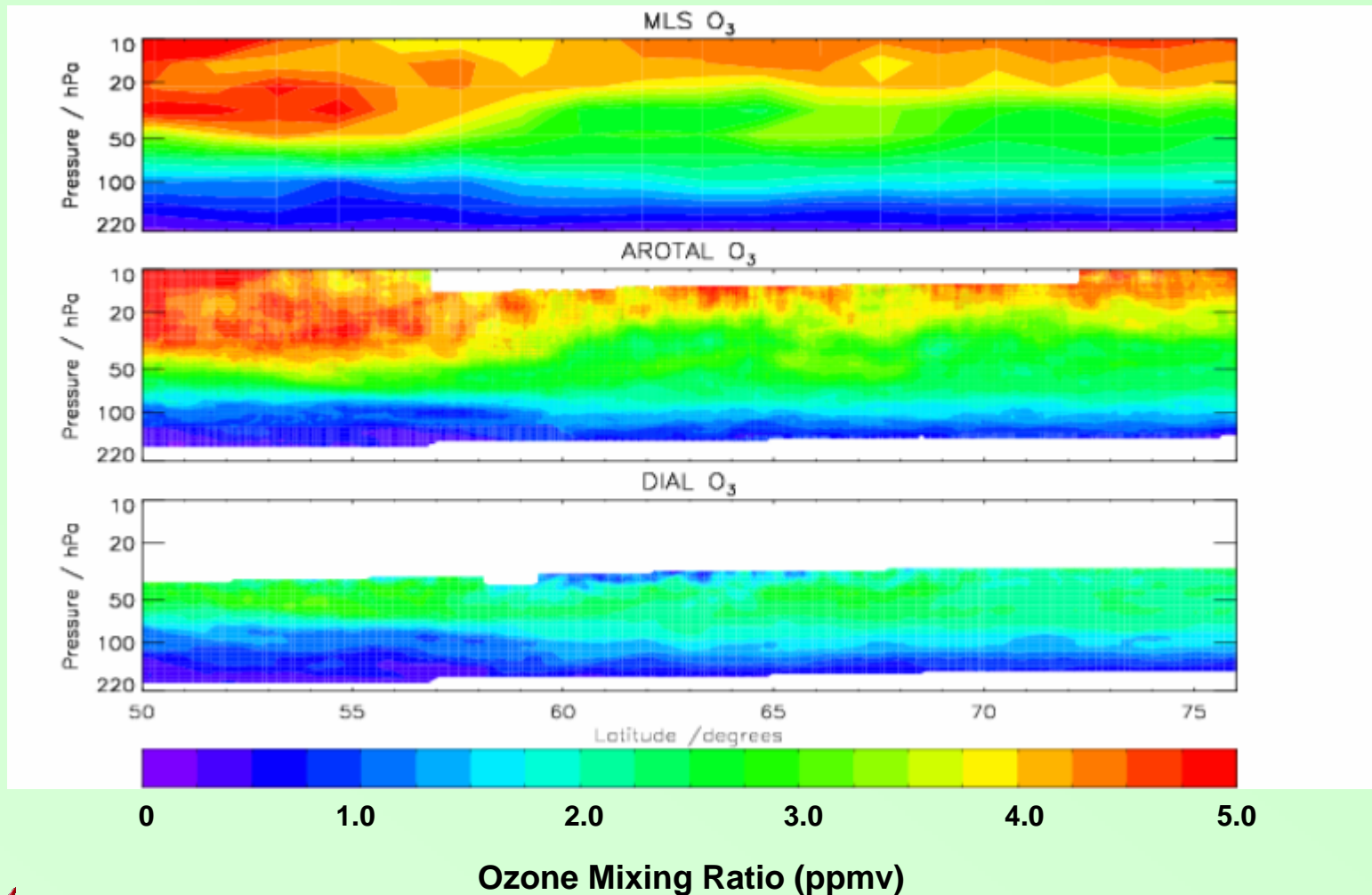
INTEX-A Data Review Meeting  
April 1, 2005

# O3 MLS Validation Results: PAVE 2005 Preliminary Data January 27, 2005

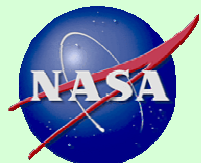
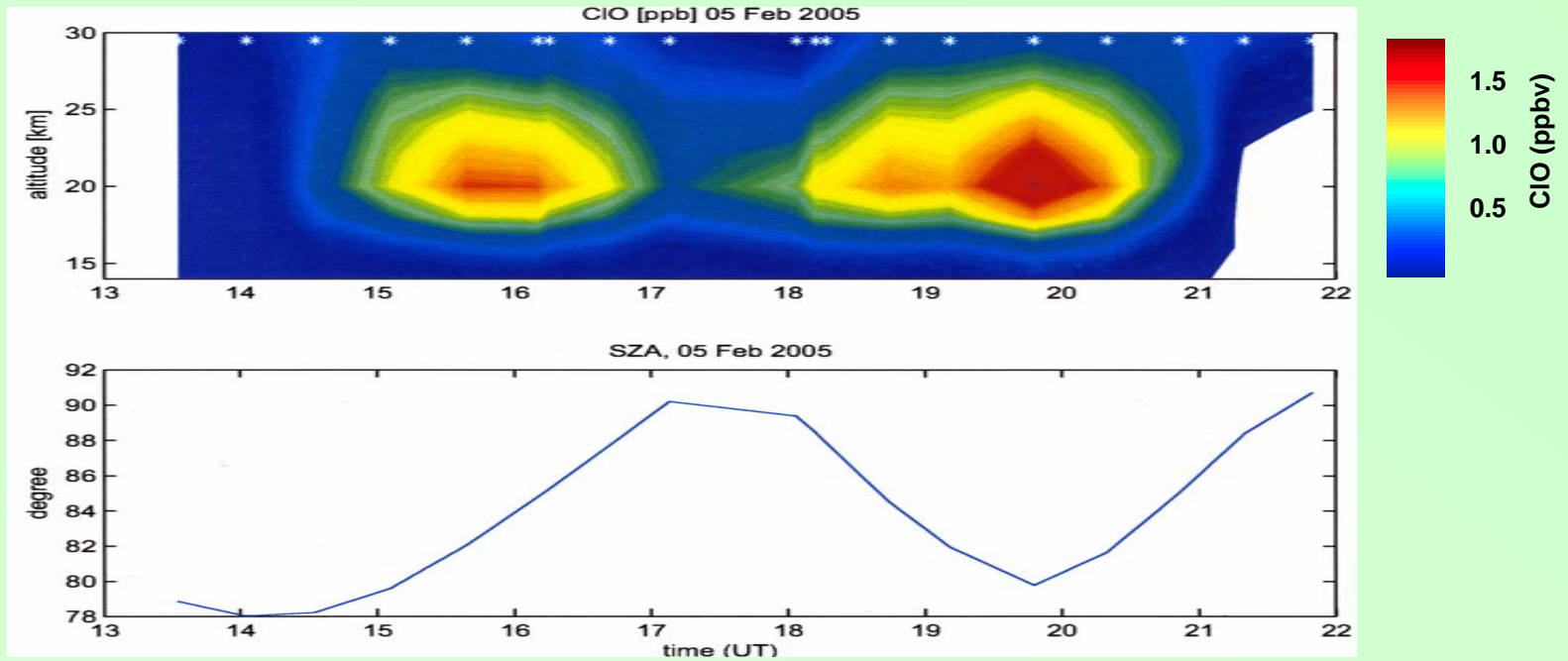
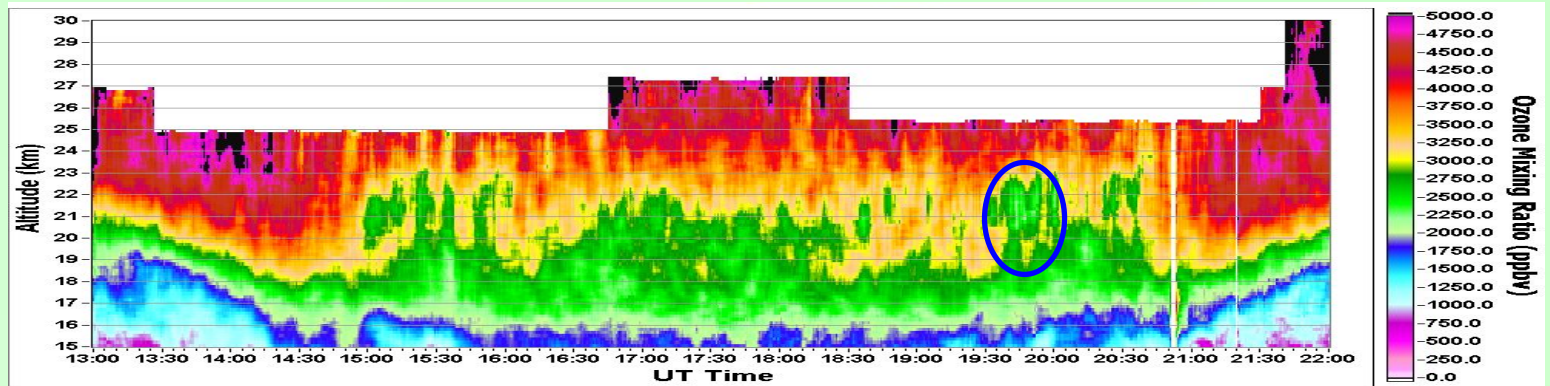




# O3 MLS Validation Results: PAVE 2005 Preliminary Data January 31, 2005

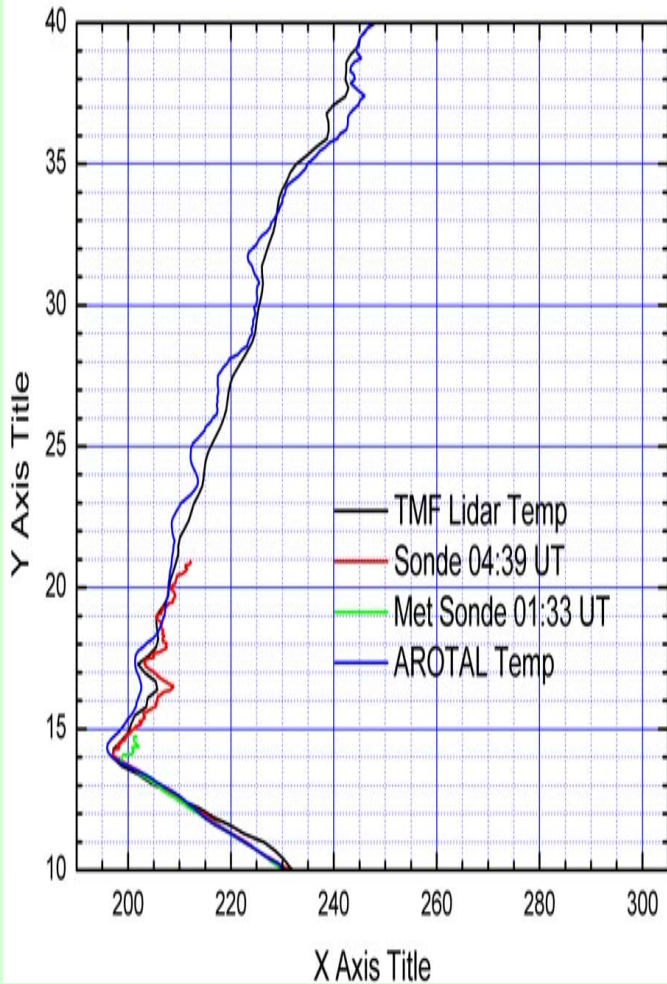


# AROTAL – ASUR Feb. 5, 2005

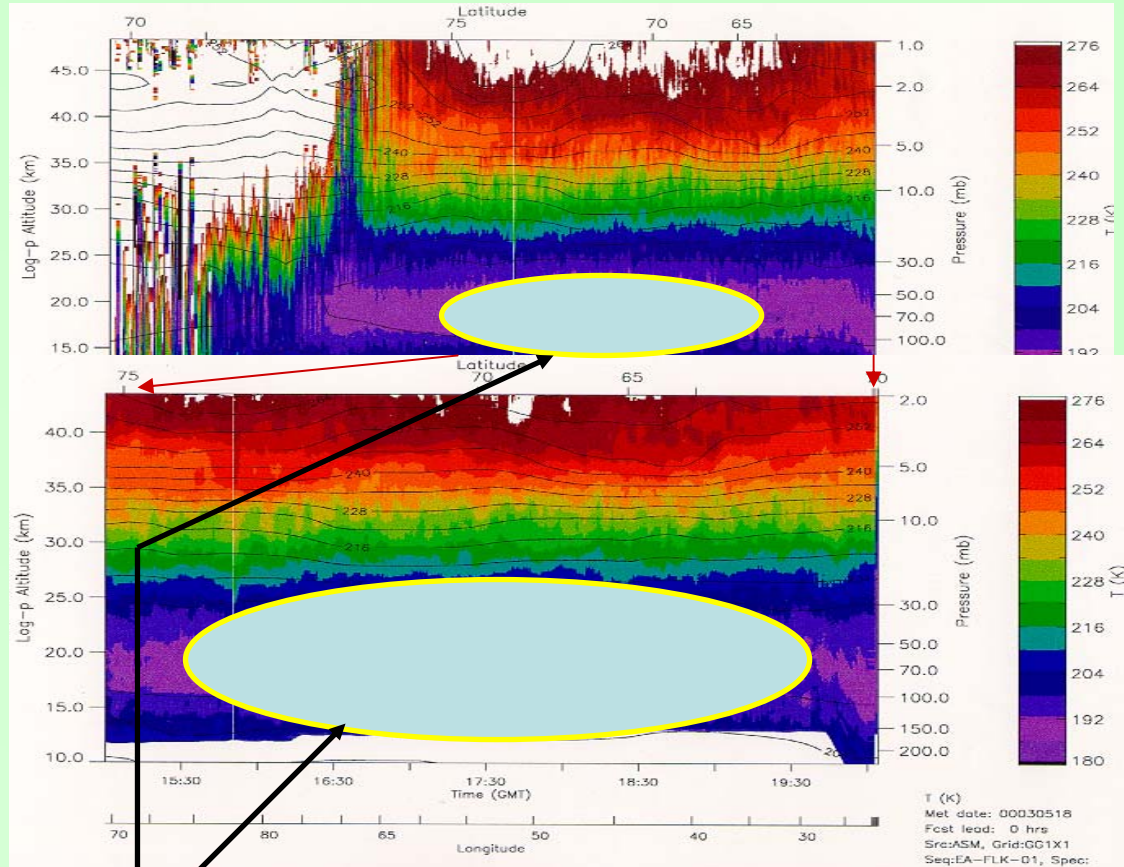


# Temperature

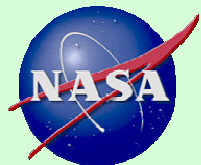
Jan 19 2005 TMF Lidar Comparison



March 5, 2000 (SOLVE)



**“Contamination” from psc’s removed by use of Raman returns**



# Conclusions

- AROTAL has demonstrated the capability to measure ozone profiles at solar zenith angles  $< 55^\circ$  (lowest SZA during the PAVE mission was around  $50^\circ$ ), and is extremely useful for validation of daylight Aura ozone measurements in the stratosphere.
- The maximum, reliable altitude of the retrieved profiles is still being determined, but is at least 23 km as demonstrated by the Boulder sonde comparison (11 – 13 km above the aircraft flight altitude)
- Temperature and aerosol, as well as ozone retrieved from Raman scattering returns, remain measurements for nighttime observation

